

REMARKS

New Claims 38-43 have been added as supported by the claims and specification as originally filed. Claims 2, 3, 5-7, 9-11, 13-15, 17-19, 23 and 24, 27, 28, 30, 32-35, 38-43 are active in this application. Claims 5-8 and 13-16 stand withdrawn from consideration.

Applicants respectfully request reconsideration of the application in view of the following remarks.

The only independent claims are Claims 23 and 24. Claim 9-12 and 17-20 depend indirectly on independent Claim 23.

Newly added product-by-process Claims 38-43 also depend on Claim 23.

Claim 23 relates to polyvinyl alcohol fibers having an extremely flattened cross-sectional profile and having a mean thickness D (μm) that satisfies the following formula (1):

$$0.4 \leq D \leq 5 \quad (1),$$

wherein

$$D = S/L;$$

D indicates the mean thickness (μm) of the fibers which is a mean length (μm) of the minor side of the cross section of the fibers;

S indicates the cross-section area (μm^2) of the fibers; and

L indicates the length (μm) of the major side of the cross section of the fibers;

wherein said polyvinyl alcohol fibers consist of polyvinyl alcohol and from 0.01 to 30 % by mass of a layered compound having a mean particle size of from 0.01 to 30 μm .

Claim 24 relates to polyvinyl alcohol fibers having an extremely thinly flattened cross-sectional profile and having a mean thickness D (μm) that satisfies the following formula (1):

$$0.4 \leq D \leq 5 \quad (1),$$

wherein

$$D = S/L;$$

D indicates the mean thickness (μm) of the fibers which is a mean length (μm) of the minor side of the cross section of the fibers;

S indicates the cross-section area (μm^2) of the fibers; and

L indicates the length (μm) of the major side of the cross section of the fibers;

wherein said polyvinyl alcohol fibers consist of polyvinyl alcohol and from 0.01 to 30 % by mass of a layered compound having a mean particle size of from 0.01 to 30 μm .

Claims 36 and 37 further define the layered compound as smectite, montmorillonite or mica.

New Claim 38 relates to a dry-process nonwoven fabric, comprising:

the polyvinyl alcohol fibers as claimed in claim 23;

wherein said dry-process fabric is obtained by

applying a water jet of 30 kg/cm^2 or more to a web that comprises said fibers,

or

needle-punching the web to a punching density of at least 250 kg/cm^2 to

thereby fibrillate said fibers.

New Claim 41 relates to a wet-process water-jet nonwoven fabric, comprising:

the polyvinyl alcohol fibers as claimed in claim 23;

wherein said wet-process water-jet nonwoven fabric is obtained by

applying a water jet of 30 kg/cm² or more to base paper prepared from a slurry
that comprises said fibers as a part of the fibrous component thereof, to
thereby fibrillate the fibers.

New Claims 39 and 42 claim that in the non-woven fabric, said fibers satisfy the
following formula (2):

$$10 \leq L/D \leq 50 \quad (2)$$

wherein

D indicates the mean thickness (μm) of the fibers; and

L indicates the length (μm) of the major side of the cross section of the fibers.

New Claims 40 and 43 claim that in the non-woven fabric, one end or both ends of
the extremely flattened cross-sectional profile of the fibers are branched.

The Examiner's attention is drawn to the scheme provided at page 12 of this paper in
support of the following arguments.

Toray's method is gel spinning with DMSO as liquid. Gel spinning is a way to fix the
form of fibers when the liquid is discharged from the spinner (graphic explanation ① in the
scheme below).

In contrast, in PVA gel spinning when using a flat spinner, PVA fiber shrinkage
occurs due to surface tension (graphic explanation ③).

The maintenance of the cross-sectional shape in Toray's method is likely due to a high fixation capacity of the acrylic gel form.

When spinning the PVA of the present invention under the same conditions as in Toray, a flat cross-sectional profile as claimed in Claims 23 and 24 of the present invention is not obtained. In other words, using Toray's method, PVA homopolymer fibers with a flat cross-sectional profile cannot be obtained.

The spinning method is used in an embodiment of the present invention is based on a solidification phase separation method (graphic explanation ④), and thus is different from the method of Toray.

In the solidification phase separation method, when PVA liquid is spun from a **circular nozzle**, a skin structure is formed first, then the interior of the structure of skin is hollowed out to form a cocoon-like structure which then collapses (graphic explanation ④).

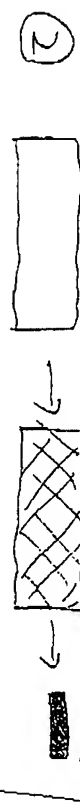
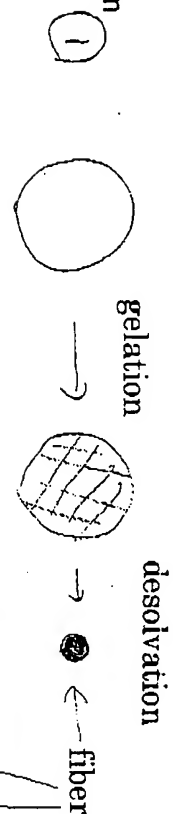
In the solidification phase separation method, when PVA liquid is spun from a **flat nozzle**, the skin is formed first, then due to surface tension a nearly elliptical cross section is formed (graphic explanation ⑤).

However, in the solidification phase separation method, in particular the addition of more filler can promote the maintenance of the skin, while inhibiting the contraction induced by surface tension. Therefore, in one embodiment, it is possible to manufacture a fiber with a flat cross-sectional profile as in the present invention (graphic explanation ⑥).

In other words, in one embodiment of the present invention, the combination of [solidification phase separation method + flat nozzle + a filler] gives PVA homopolymer fibers having a flat cross-sectional profile. This is not disclosed or suggested by Toray and Ueda and Howard.

1. acrylic gel spinning

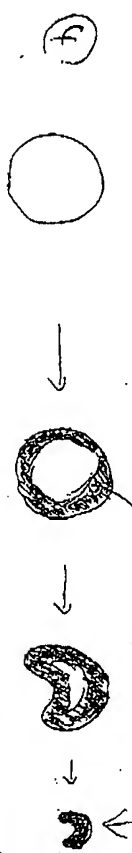
graphic explanation



PVA gel spinning



2. solidification phase separation spinning skin



The present invention



The advantages associated with using a layered compound as claimed is disclosed in the specification as follows.

The specification discloses at page 3, last paragraph:

“The present inventors have assiduously studied and, as a result, have found that, when PVA fibers are processed to have an extremely flattened cross-sectional profile, then the fibers can be readily fibrillated even though any foreign polymer as in the related art is not added thereto. In addition, the present inventors have further found that, **when a layered compound is added thereto, the cross-sectional profile of the fibers may be much more flattened.** The present inventors also found that the flattened PVA fibers of the present invention can be fibrillated without compromising their physical properties such as chemical resistance, hydrophilicity, weather resistance and tenacity.”

The specification discloses at page 7, lines 4-24:

“Along with the PVA resin as above, the PVA fibers of the present invention may **contain a layered compound** added thereto. Containing a **layered compound**, the fibers could be more readily split. The layered compound is, for example, smectite, montmorillonite or mica. It may be a natural product or a synthetic product. However, in order to be able to add the compound to the spinning solution for the fibers, the mean particle size of the **compound** preferably falls between 0.01 and 30 μm . The mean particle size includes all values and subvalues therebetween, especially including 0.05, 0.1, 0.5, 1, 5, 10, 15, 20 and 25 μm . If the mean particle size thereof is larger than 30 μm , then the compound may clog spinning nozzles and filters and would interfere with good spinning operation. On the other hand, if the mean particle size thereof is smaller than 0.01 μm , the layered compound particles would aggregate and, as a result, the resulting secondary particles would be larger than tens μm and would clog spinning nozzles and filters, therefore interfering with good spinning operation. More preferably, the mean particle size of the compound is from 0.1 to 10 μm . The amount of the layered compound to be added to the fibers is preferably from 0.01 to 30 % by mass of the fibers. The amount of layered compound to be added to the fibers includes all values and subvalues therebetween, especially including 0.05, 0.1, 0.5, 1, 5, 10, 15, 20 and 25% by mass. If the amount is smaller than 0.01 % by mass, then the

compound would be ineffective for improving the splittability of the fibers. On the contrary, if the amount is larger than 30 % by mass, then the spinning nozzle stability would be poor and, in addition, the physical properties of the fibers produced would significantly worsen. More preferably, the amount is from 0.1 to 10 % by mass.”

The specification discloses at page 15, lines 1-11:

“The PVA fibers of the present invention may be readily split into single fibers, when having received shear force applied thereto. They can be readily fibrillated without compromising the physical properties such as the chemical resistance, the hydrophilicity the weather resistance and the tenacity thereof. The fibrillated fibers may be formed into dry-process or wet-process nonwoven fabrics. In addition, the dry-process and wet-process nonwoven fabrics formed of the fibrillated fibers of the present invention are superior to those formed of conventional fibrillated fibers in point of the water absorbability and the wiping potency thereof. Further, when the fibrillated PVA fibers of the present invention are sheeted along with a cement slurry, then they may form wet-process slates. When the fibers of the present invention are kneaded with plastic or rubber, then they may form plastic or rubber products reinforced with the fibrillated PVA fibers.”

While based on the Examples of Toray (JP49-100327), the present application and Toray are overlapping in terms flatness ratio ($10 \leq L/D \leq 50$) and thickness ($0.4 \leq D \leq 5$).

However, when PVA alone is used, even if above parameters are satisfied, the fiber will not fibrillate. Thus, in one embodiment of the present invention, a layered compound is used in order to achieve fibrillation.

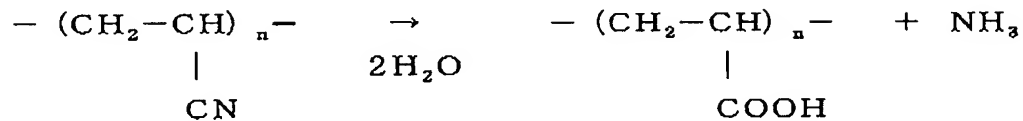
In contrast, Toray has a heterogeneous polymer blend approach to achieve fibrillation.

An advantage of the present application is the superior chemical resistance (especially, alkaline resistance) compared to Toray.

In contrast, in Toray, a blend of polyvinyl alcohol, polyacrylonitrile and acrylonitrile vinyl alcohol graft copolymer is dissolved in a solvent and spun and drawn to give fibers.

Thus, the claimed polyvinyl alcohol fibers of the present invention cannot be anticipated by the fibers containing a polymer blend as disclosed in Toray.

Toray discloses the use of acrylonitrile which is detrimental to the hydrolysis resistance of the fibers of Toray.



However, the claimed fibers of the present invention are hydrolysis resistant and hydrolysis as in the fibers of Toray does not occur.

Further, acrylonitrile is excluded from Claims 23 and 24 due to the use of “consisting of”. Since Toray uses acrylonitrile, it teaches away from the use of hydrolysis resistant fibers. Moreover, Ueda discloses the use of water-soluble PVA fibers. Note that Ueda discloses underwater disintegrable fiber materials. See, for example, col. 1, lines 50 to col. 2, line 19. Thus, even the combination of Ueda with Toray cannot result in or render obvious the present invention.

In addition, new Claims 36 and 37 are not disclosed or suggested by the combination of Ueda with Toray.

Howard does not cure the defects of the combination of Ueda with Toray.

Howard adds fine particles to give wettability to polyolefin. However, there is no mention of a layered compound, in particular for the purpose of fibrillating the fibers in Howard.

Further, the examples in the specification show that excellent fibrillability, hydrophobicity, chemical resistance and wiping potency are obtained using the claimed fiber of the present invention. Table 1 below is copied from page 14 of the specification.

In support of the above argument Applicants previously provided JP 9059872 and a translation thereof (both filed by IDS). At page 7, paragraph [0049], Example 1, it is disclosed that acrylonitrile is hydrolyzed with sodium hydroxide. However, the Examples of the present invention show that the fibers of the present invention are resistant to sodium hydroxide. See Table 1 below "Chemical Resistance". The "dissolution" is measured after dipping in sodium hydroxide for 8 hours and is very small. (See page 10, lines 9-15 of the specification for the experimental procedure for determining the dissolution in sodium hydroxide).

Thus, the fibers of the present invention have a good hydrolysis resistance and are different from the fibers of Toray and the fibers of Ueda or a combination thereof.

Table 1

	Cross-Sectional Profile	D (μm)	L/D	Fibrillability Microscopic Observation	Hydrophilicity		Chemical Resistance		Wiping Potency	
					Water-Absorbing Speed (mm/5 min)	Result	Dissolution (%)	Result	Residue after Wiping (%)	Result
Example 1	flattened	3	15	good	124	good	<1	good	4.0	good
Example 2	flattened	3	21	good	128	good	<1	good	3.1	good
Example 3	flattened	3	25	good	123	good	<1	good	5.0	good
Comparative Example 1	flattened	3	4	not good	125	good	<1	good	14.8	not good
Comparative Example 2	cocoon-shaped	-	-	not good	111	good	<1	good	15.1	not good
Comparative Example 3	rounding	-	-	good	98	not good	19	not good	9.8	not good

As stated at page 15, 1st paragraph of the specification:

The PVA fibers of the present invention may be readily split into single fibers, when having received shear force applied thereto. They can be readily fibrillated without compromising the physical properties such as the chemical resistance, the hydrophilicity the weather resistance and the tenacity thereof. The fibrillated fibers may be formed into dry-process or wet-process nonwoven fabrics. In addition, the dry-process and wet-process nonwoven fabrics formed of the fibrillated fibers of the present invention are superior to those formed of conventional fibrillated fibers in point of the water absorbability and the wiping potency thereof. Further, when the fibrillated PVA fibers of the present invention are sheeted along with a cement slurry, then they may form wet-process slates. When the fibers of the present invention are kneaded with plastic or rubber, then they may form plastic or rubber products reinforced with the fibrillated PVA fibers.

The excellent properties of the claimed PVA fibers having the claimed dimensions is not disclosed or suggested in Toray and Ueda and Howard.

Therefore, the rejection of the claims over Toray and Ueda and Howard are believed to be unsustainable as the present invention is neither anticipated nor obvious and withdrawal of this rejection is respectfully requested.

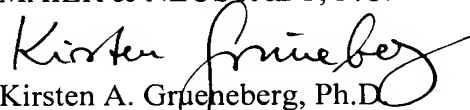
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This application presents allowable subject matter, and the Examiner is kindly requested to pass it to issue. Should the Examiner have any questions regarding the claims or otherwise wish to discuss this case, he is kindly invited to contact Applicants' below-signed representative, who would be happy to provide any assistance deemed necessary in speeding this application to allowance.

Respectfully submitted,

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